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मानक

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IS 9158 (1979): Cold-drawn high pressure fluid power cylinder tubes [MTD 19: Steel Tubes, Pipes and Fittings]



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Bhartrhari—Nitiśatakam

“Knowledge is such a treasure which cannot be stolen”



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IS : 9158 - 1979

*Indian Standard*  
SPECIFICATION FOR  
COLD-DRAWN HIGH PRESSURE FLUID  
POWER CYLINDER TUBES

UDC 621.643.2-986 [ 669.14-462-124.2 ] : 621.8.032



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**INDIAN STANDARDS INSTITUTION**  
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG  
NEW DELHI 110002

*September 1979*

AMENDMENT NO. 1 NOVEMBER 1980

TO

IS:9158-1979 SPECIFICATION FOR COLD-DRAWN HIGH  
PRESSURE FLUID POWER CYLINDER TUBES

Corrigendum

[Page 7, clause 17.2(a), line 3] - Substitute  
'+ 0.10 mm' for '+ 0.10 mm'.

(SMDC 22)

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Reprography Unit, ISI, New Delhi, India

*Indian Standard*  
**SPECIFICATION FOR**  
**COLD-DRAWN HIGH PRESSURE FLUID**  
**POWER CYLINDER TUBES**

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**IS : 9158 - 1979**

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Panel for Preparation of Specification for Cold-Drawn High  
Pressure Fluid Power Cylinder Tubes, SMDC 22 : P25  
( Including Applications Like Shock Absorbers,  
Pneumatic Cylinders, Etc )

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*Indian Standard*  
SPECIFICATION FOR  
COLD-DRAWN HIGH PRESSURE FLUID  
POWER CYLINDER TUBES

0. FOREWORD

**0.1** This Indian Standard was adopted by the Indian Standards Institution on 21 May 1979, after the draft finalized by the Steel Tubes, Pipes and Fittings Sectional Committee had been approved by the Structural and Metals Division Council.

**0.2** In fluid power system, power is transmitted and controlled through a fluid ( liquid or gas ) under pressure within an enclosed circuit. One component of such system is the fluid power cylinder.

**0.3** In preparing this standard assistance has been derived from the following:

ISO/DIS 4394 Fluid power systems and components — cylinder barrels — Requirements for steel tubes with specially finished bores. International Organization for Standardization.

BS : 5242 : Part I : 1975 Specification for tubes for fluid power cylinder barrels : Part I Steel tubes with specially finished bores. British Standards Institution, London.

**0.4** For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS : 2-1960\*. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

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**1. SCOPE**

**1.1** This standard covers the requirements of the following types of cold-drawn high pressure fluid power cylinder tubes ( including applications like shock absorbers, pneumatic and hydraulic cylinders, etc ):

- a) Cold-drawn electric resistance welded ( CEW ), and
- b) Cold-drawn seamless tubes ( CDS ).

**1.2** This standard does not include tubes with specially machined bores.

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\*Rules for rounding off numerical values ( revised ).



## SECTION I GENERAL REQUIREMENTS

### 2. SUPPLY OF MATERIAL

2.1 General requirements relating to the supply of material shall be as laid down in IS 1337-1967\*.

### 3. WORKMANSHIP

3.1 The tubes shall be well finished, clean and free from harmful defects. The ends of the tubes shall be cut square and free from burrs.

3.2 Cylinder bore shall be absolutely free from pits, scratches, sliver lines, fin marks or any other surface irregularities which may effect the functioning. However imperfections in scores and pits shall be permissible to the extent permitted in 10.1.

### 4. STRAIGHTNESS

4.1 Tubes shall not depart from a straightness by more than Class A ( 1 in 1000 ) and Class B ( 1.5 in 1000 ) of any measured length at the centre of the length. The class of tolerance shall be as agreed to between the purchaser and the manufacturer.

### 5. MECHANICAL TESTING

5.1 The manufacturer shall be responsible for making mechanical tests to ensure that the material and tubes comply with the requirements of this Indian Standard. If desired by the purchaser, the manufacturer shall supply a certificate stating that the tubes comply with the specific requirements. Where the purchaser desires to witness the tests, this shall be stated in the enquiry or order. Where the purchaser requires tests specifically related to his particular order, the tests, shall be the subject of agreement between the purchaser and the manufacturer.

### 6. TESTING PROCEDURE

6.1 **Tensile Test** — Test pieces shall be taken from the ends of selected tubes and tested in accordance with IS : 1894-1972†.

### 7. RETESTS

7.1 If a tube selected for the test fails in any one or more of the tests specified, two further tests of the same kind shall be made from the same or other tube at the manufacturer's discretion.

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\*General requirements for the supply of metallurgical materials ( *first revision* ).

†Method for tensile testing of steel tubes ( *first revision* ).

7.2 If the repeat tests are satisfactory the tubes shall be accepted provided that in all respects they comply with the requirements of this standard.

**8. NUMBER OF MECHANICAL TESTS**

8.1 Where the purchaser requires tests specifically related to his order, the number of tests shall be at the rate of one set of tests per 1 000 metres for CDS tubes and 500 metres for CEW tubes or part thereof

**9. TOLERANCE ON LENGTH**

9.1 Tolerances on tubes ordered to cut lengths, when specified, shall meet the following requirements:

| <i>Length</i> |       | <i>Tolerance</i> |
|---------------|-------|------------------|
| Over          | to    |                  |
| mm            | mm    | mm               |
| 0             | 2 000 | - 0 + 3          |
| 2 000         | 5 000 | - 0 + 5          |
| 5 000         | —     | - 0 + 10         |

These tolerances include the possible out of squareness of the ends of the tubes

**10. BORE SURFACE**

10.1 Tubes with a drawn bore surface finish may exhibit surface imperfections subject to the following limits:

| <i>Outside Diameter</i> |                     | <i>Thickness Range</i> |                     | <i>Permissible Depth of Imperfection</i> |                 |
|-------------------------|---------------------|------------------------|---------------------|--|-----------------|
| Over                    | Up to and Including | Over                   | Up to and Including | Scores                                   | Pits            |
| mm                      | mm                  | mm                     | mm                  | μm                                       | μm              |
| —                       | 63                  | { —<br>2.6<br>6.3      | { 2.6<br>6.3<br>—   | 25<br>25<br>25                           | 40<br>50<br>65  |
| 63                      | 112                 | { —<br>3.2<br>4.5      | { 3.2<br>4.5<br>—   | 40<br>40<br>50                           | 65<br>75<br>100 |
| 112                     | 130                 | All                    | All                 | 50                                       | 100             |
| 130                     | 200                 | All                    | All                 | 80                                       | 150             |
| 200                     | —                   | All                    | All                 | 100                                      | 200             |

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## **11. SURFACE PROTECTION**

**11.1** The tubes shall be light oiled inside and outside to avoid rusting during transit and storage

## **12. PACKING**

**12.1** The special requirements for packing shall be agreed to between the supplier and the purchaser. Otherwise the supplier's normal practice shall be adopted.

## **13. METHOD OF ORDERING**

**13.1** While ordering the material, the purchaser shall furnish the information as given in Appendix A.

## **14. MARKING**

**14.1** Each tube may also be marked with the ISI Certification Mark.

**NOTE** — The use of the ISI Certification Mark is governed by the provisions of the Indian Standards Institution ( Certification Marks ) Act and the Rules and Regulations made thereunder. The ISI Mark on products covered by an Indian Standard conveys the assurance that they have been produced to comply with the requirements of that standard under a well-defined system of inspection, testing and quality control which is devised and supervised by ISI and operated by the producer. ISI marked products are also continuously checked by ISI for conformity to that standard as a further safeguard. Details of conditions under which a licence for the use of the ISI Certification Mark may be granted to manufacturers or processors, may be obtained from the Indian Standards Institution.

## **SECTION 2 SPECIFIC REQUIREMENTS FOR COLD-DRAWN ELECTRIC RESISTANCE WELDED TUBES**

### **15. SCOPE**

**15.1** This section provides for the cold-drawn electric resistance welded tubes and covers the following grades:

CEW — 1

CEW — 2

The tubes shall comply in all respects with the requirements specified in Section 1 and with the relevant requirements of this section, and shall be subjected to both the chemical analysis and mechanical tests, unless it is stated on the order that only the chemical analysis or the mechanical tests are required.

## 16. CHEMICAL COMPOSITION

**16.1** Sulphur and phosphorus shall not exceed 0.05 percent maximum each.

**16.1.1** If the tubes are to be subjected to a subsequent welding operation, the steel analysis for all grades shall conform to the following requirements:

- a) the carbon content shall not exceed 0.25 percent;
- b) the carbon equivalent ( CE ), as defined by the formula:

$$CE = \text{Percent C} + \frac{\text{Percent Mn}}{6} + \frac{\text{Percent Ni} + \text{Percent Cu}}{15} + \frac{\text{Percent Cr} + \text{Percent Mo} + \text{Percent V}}{5}$$

shall be  $\leq 0.50$

## 17. DIMENSIONS AND TOLERANCES

**17.1 Dimensions** — Dimensions shall be as agreed to between the purchaser and the manufacturer

**17.2** The tolerance on tubes shall be as under:

- a) *Tolerance on Mean Inside Diameter and Outside Diameter* — No tube shall have a mean inside and outside diameter that departs from the specified values by more than + 0.10 mm for tubes up to and including 40 mm diameter with the addition, for larger tubes, of  $\pm 0.025$  mm for each 15 mm or part thereof over 40 mm diameter.
- b) *Ovality* — Should not exceed 0.080 mm anywhere along the length of every tube.

## 18. MECHANICAL PROPERTIES

**18.1** The mechanical properties obtained from test pieces selected and prepared as specified in Section 1 shall be within the limits specified in Table 1.

## 19. CRUSHING TEST

**19.1** The test piece shall be crushed endwise until its height is reduced, without cracking, splitting or opening at the weld, by at least the specified percentage of the original height. The height of the test piece shall be about  $1\frac{1}{2}$  times the outside diameter of the tube and the ends be cut square to the axis of the tube. The percentage reduction in height shall not be less than 25 percent.

**TABLE 1 MECHANICAL PROPERTIES OF CEW TUBES**  
( Clause 18.1 )

| IS REFERENCE NUMBER | ULTIMATE TENSILE STRESS, MPa | YIELD STRESS OR 0.2 PROOF STRESS, MPa | ELONGATION PERCENT ON $5.65\sqrt{A}$ | BHN VALUE |
|---------------------|------------------------------|---------------------------------------|--------------------------------------|-----------|
|                     | Min                          | Min                                   | Min                                  | Min       |
| CEW — 1             | 430                          | 350                                   | 6                                    | 120       |
| CEW — 2             | 540                          | 430                                   | 5                                    | 155       |

NOTE 1 — 0.2 percent proof stress shall be obtained, if the yield stress is difficult to obtain

NOTE 2 — *A* is the area of cross section at gauge length.

NOTE 3 — UTS and YS are mandatory, but BHN values are given for information only

$$1 \text{ MPa} = 1 \text{ N/mm}^2 = 0.1020 \text{ kg/mm}^2$$

**SECTION 3 SPECIFIC REQUIREMENT FOR COLD-DRAWN SEAMLESS STEEL TUBES**

**20. SCOPE**

20.1 This section provides for the cold-drawn seamless steel tubes and covers the following grades:

- CDS — 1
- CDS — 2
- CDS — 3

The tubes shall comply in all respects with the requirements specified in Section 1 and with the relevant requirements of this section, and shall be subjected to both the chemical analysis and mechanical tests, unless it is stated on the order that only the chemical analysis or the mechanical tests are required.

**21. CHEMICAL COMPOSITION**

21.1 The ladle analysis shall conform to the following limits:

| IS Reference No. | C<br>Percent |      | Mn<br>Percent |      | S <sub>1</sub><br>Percent | S<br>Percent | P<br>Percent |
|------------------|--------------|------|---------------|------|---------------------------|--------------|--------------|
|                  | Min          | Max  | Min           | Max  | Max                       | Max          | Max          |
|                  |              |      |               |      |                           |              |              |
| CDS — 1          | —            | 0.20 | —             | —    | —                         | 0.050        | 0.050        |
| CDS — 2          | 0.10         | 0.30 | 0.40          | 1.20 | 0.35                      | 0.050        | 0.050        |
| CDS — 3          | 0.30         | 0.50 | 0.40          | 1.20 | 0.35                      | 0.050        | 0.050        |

**21.1.1** Where the tubes are subjected to subsequent welding, chemical composition shall be subject to agreement between the manufacturer and the purchaser

## 22. DIMENSIONS AND TOLERANCES

**22.1 Preferred Sizes** — Preferred sizes for high pressure fluid power cylinder barrels for cold finished steel tubes shall be as given in Appendix B.

**22.2** The tolerance on tubes shall be as under:

- a) *Tolerance on Mean Outside Diameter* — No tube shall have a mean outside diameter that departs from the specified values by more than  $\pm 0.10$  mm for tubes up to and including 40 mm diameter with the addition, for larger tubes, of  $\pm 0.025$  mm for each 15 mm or part thereof over 40 mm diameter.
- b) *Eccentricity* — Shall be restricted so that the minimum thickness 'a' *min* anywhere along the tube does not fall more than 10 percent below the minimum mean thickness implied by the diametral tolerances:

$$\text{that is 'a' Min} \geq 0.9 \times \frac{D \text{ Min} - d \text{ Max}}{2}$$

where

$D$  = outer diameter, and

$d$  = internal diameter.

## 23. MECHANICAL PROPERTIES

**23.1** The mechanical properties obtained from test pieces selected and prepared as specified in Section 1 shall be within the limits specified in Table 2.

TABLE 2 MECHANICAL PROPERTIES OF CDS TUBES

| IS REFERENCE<br>NUMBER | ULTIMATE TENSILE<br>STRESS,<br>MPa | YIELD STRESS<br>OR 0.2 PERCENT<br>PROOF STRESS,<br>MPa | ELONGATION<br>PERCENT<br>ON $5.65\sqrt{A}$ | BHN<br>VALUE |
|------------------------|------------------------------------|--|--|--------------|
|                        | <i>Min</i>                         | <i>Min</i>   | <i>Min</i>                                 |              |
| CDS — 1                | 430                                | 350  | 6  | 120          |
| CDS — 2                | 540                                | 430  | 5  | 155          |
| CDS — 3                | 650                                | 540  | 4  | 190          |

NOTE 1 — 0.2 percent proof stress shall be obtained, if the yield stress is difficult to obtain.

NOTE 2 —  $A$  is the area of cross section at gauge length.

NOTE 3 — UTS and YS are mandatory, but BHN values are given for information only.

**IS : 9158 - 1979**

## **24. HYDRAULIC TEST**

**24.1** When required by the purchaser, each tube shall be tested, at the manufacturer's works and shall withstand a hydraulic pressure of 1.5 times the design pressure subject to a minimum of 7 N/mm<sup>2</sup> but not greater than the pressure calculated by the following formula:

$$P = \frac{2 \times s \times t}{D}$$

where

*P* = test pressure,

*s* = stress which shall be taken as 40 percent of the minimum tensile strength at room temperature,

*t* = thickness of the tube in mm, and

*D* = outside diameter of the tube in mm.

The pressure shall be maintained in each tube for at least 3 seconds and there shall be no sign of leakage during the test.

## **A P P E N D I X A**

( *Clause 13.1* )

### **RECOMMENDED METHOD OF ORDERING**

**A-1.** The purchaser should specify the following in his enquiry and order:

- a) The method of manufacture, that is, seamless or welded.
- b) The number of this Indian Standard, IS : 9158-1979.
- c) If the tubes are to be subjected to a welding operation.
- d) The grade of material as per 15.1 and 20.1.
- e) The bore of tube.
- f) The random length required.
- g) Any special requirements for protection or packing.

**A P P E N D I X B**  
( Clause 22.1 )  
**PREFERRED SIZES FOR HIGH PRESSURE FLUID POWER CYLINDER BARRELS**

**B-1.** The following are the preferred sizes for high pressure fluid power cylinder barrels made from cold finished steel tubes:

| Bore<br>mm | Call Up Size<br>Including Honing<br>Allowance, mm |          | Thickness ( mm )        |     |     |     |     |     |     |     |      |      |      |      |
|------------|---|----------|-------------------------|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|
|            |   |          | Outside Diameter ( mm ) |     |     |     |     |     |     |     |      |      |      |      |
|            |   |          | 1.5                     | 2.0 | 2.5 | 3.0 | 3.5 | 5.0 | 6.0 | 7.5 | 10.1 | 12.5 | 15.0 | 20.0 |
| 25         | 24.66   | to 24.78 | 28                      | —   | —   | 31  | —   | 35  | —   | 40  | —    | —    | —    | —    |
| 32         | 31.66   | ” 31.78  | 35                      | 36  | —   | 38  | —   | 42  | —   | 47  | —    | —    | —    | —    |
| 40         | 39.66   | ” 39.78  | —                       | —   | 45  | 46  | —   | 50  | —   | 55  | —    | —    | —    | —    |
| 50         | 49.64   | ” 49.80  | —                       | —   | 55  | 56  | —   | 60  | —   | 65  | 70   | 75   | —    | —    |
| 63         | 62.60   | ” 62.82  | —                       | —   | 68  | 69  | —   | 73  | 75  | 76  | 83   | 88   | —    | —    |
| 80         | 79.54   | ” 79.76  | —                       | —   | 85  | 86  | —   | 90  | 92  | 95  | 100  | 105  | 110  | —    |
| 100        | 99.40   | ” 99.70  | —                       | —   | 105 | 106 | —   | 110 | 112 | 115 | 120  | 125  | 130  | —    |
| 125        | 124.22  | ” 124.64 | —                       | —   | —   | —   | 132 | 135 | 137 | 140 | 145  | 150  | 155  | 165  |
| 160        | 158.98  | ” 159.58 | —                       | —   | —   | —   | 167 | 170 | —   | 175 | 180  | 185  | 190  | 200  |
| 200        | 198.91  | ” 199.49 | —                       | —   | —   | —   | —   | 210 | —   | 215 | 220  | 225  | 230  | 240  |



**INDIAN STANDARDS**  
**ON**  
**STEEL TUBES, PIPES AND FITTINGS**

IS:

- 1161-1968 Steel tubes for structural purposes ( *second revision* )
- 1239 ( Part I )-1973 Mild steel tubes, tubulars and other wrought steel fittings: Part I  
Mild steel tubes ( *third revision* )
- 1239 ( Part II )-1969 Mild steel tubes, tubulars and other wrought steel fittings: Part II  
Mild steel tubulars and other wrought steel pipe fittings ( *second revision* )
- 1894-1972 Method for tensile testing of steel tubes ( *first revision* )
- 1914 ( Parts I to IV )-1977 Carbon steel boiler tubes and superheater tubes ( *first revision* )
- 1978-1971 Line pipe ( *first revision* )
- 1979-1971 High test line pipe ( *first revision* )
- 2039-1964 Steel tubes for bicycle and allied purposes
- 2328-1963 Method for flattening test on steel tubes
- 2329-1963 Method for bend test on steel tubes
- 2330-1963 Method for flanging test on steel tubes
- 2335-1963 Method for drift expanding test on steel tubes
- 2416-1963 Boiler and superheater tubes for marine and naval purposes
- 2484-1979 Dimensions for steel tubes for bicycle purposes ( *first revision* )
- 3074-1965 Steel tubes for automotive purposes
- 3589-1966 Electrically welded steel pipes for water, gas and sewage ( 200 to 2 000 mm nominal diameter )
- 3601-1966 Steel tubes for mechanical and general engineering purposes
- 3609-1966 Chrome molybdenum steel, seamless, boiler and superheater tubes
- 4270-1967 Steel tubes used for water wells
- 4310-1967 Weldable steel pipe fittings for marine purposes
- 4516-1968 Elliptical mild steel tubes
- 4711-1974 Methods for sampling of steel pipes, tubes and fittings ( *first revision* )
- 4712-1968 Dimensions for forged steel socket-welding fittings
- 4922-1968 Seamless steel tubes ( suitable for welding ) for aircraft purposes
- 4923-1968 Hollow steel sections for structural use
- 5429-1979 Dimensions for steel tubes for automotive purposes ( *first revision* )
- 5433-1969 Oil well steel casing pipes and couplings
- 5504-1969 Spiral welded pipes
- 5929-1970 Inspection and testing procedure for circular steel tubes for aircraft purposes
- 6011-1970 Carbon steel tubes for use on board ships for pressure service
- 6286-1971 Seamless and welded steel pipe for sub-zero temperature service
- 6392-1971 Steel pipe flanges
- 6630-1972 Seamless ferritic alloy steel pipes for high temperature service
- 6631-1972 Steel pipes for hydraulic purposes
- 6647-1972 Drill pipes for use in oil or natural gas wells
- 6913-1973 Stainless steel tubes for the food and beverage industry
- 7138-1973 Steel tubes for furniture purposes
- 7174-1974 Carbon steel tubes for use on board ships for working pressures 0.7 to 1.7 N/mm<sup>2</sup>
- 8036-1976 Mild steel transformer cooling tubes
- 8119-1976 Copper brazed steel tubing

## INTERNATIONAL SYSTEM OF UNITS ( SI UNITS )

### Base Units

| QUANTITY                  | UNIT     | SYMBOL |
|---------------------------|----------|--------|
| Length                    | metre    | m      |
| Mass                      | kilogram | kg     |
| Time                      | second   | s      |
| Electric current          | ampere   | A      |
| Thermodynamic temperature | kelvin   | K      |
| Luminous intensity        | candela  | cd     |
| Amount of substance       | mole     | mol    |

### Supplementary Units

| QUANTITY    | UNIT      | SYMBOL |
|-------------|-----------|--------|
| Plane angle | radian    | rad    |
| Solid angle | steradian | sr     |

### Derived Units

| QUANTITY             | UNIT    | SYMBOL | DEFINITION                      |
|----------------------|---------|--------|---------------------------------|
| Force                | newton  | N      | 1 N = 1 kg.m/s <sup>2</sup>     |
| Energy               | joule   | J      | 1 J = 1 N.m                     |
| Power                | watt    | W      | 1 W = 1 J/s                     |
| Flux                 | weber   | Wb     | 1 Wb = 1 V.s                    |
| Flux density         | tesla   | T      | 1 T = 1 Wb/m <sup>2</sup>       |
| Frequency            | hertz   | Hz     | 1 Hz = 1 c/s (s <sup>-1</sup> ) |
| Electric conductance | siemens | S      | 1 S = 1 A/V                     |
| Electromotive force  | volt    | V      | 1 V = 1 W/A                     |
| Pressure, stress     | pascal  | Pa     | 1 Pa = 1 N/m <sup>2</sup>       |

### INDIAN STANDARDS INSTITUTION

Manak Bhavan, 9 Bahadur Shah Zafar Marg, NEW DELHI 110002

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Telegrams : Manaksanstha

#### Regional Offices :

|  |                 | Telephone |
|--|-----------------|-----------|
| Western : Novelty Chambers, Grant Road | BOMBAY 400007   | 37 97 29  |
| Eastern : 5 Chowringhee Approach       | CALCUTTA 700072 | 23-08 02  |
| Southern : C I T Campus, Adyar         | MADRAS 600020   | 41 24 42  |

#### Branch Offices :

|   |                     |          |
|---|---------------------|----------|
| 'Pushpak', Nurmohamed Shaikh Marg, Khanpur  | AHMADABAD 380001    | 2 03 91  |
| 'F' Block, Unity Bldg, Narasimharaja Square | BANGALORE 560002    | 2 76 49  |
| Gangotri Complex, Bhadbhada Road, T T Nagar | BHOPAL 462003       | 6 27 16  |
| 22E Kalpana Area                            | BHUBANESHWAR 751014 | 5 36 27  |
| Ahimsa Bldg, SCO 82-83, Sector 17C          | CHANDIGARH 160017   | 2 83 20  |
| 6-8-56/57 L. N. Gupta Marg                  | HYDERABAD 500001    | 22 10 83 |
| D-277 Todarmal Marg, Banipark               | JAIPUR 302006       | 6 98 32  |
| 117/418 B Sarvodaya Nagar                   | KANPUR 208005       | 8 12 72  |
| Patliputra Industrial Estate                | PATNA 800013        | 6 28 08  |
| Hantex Bldg ( 2nd Floor ), Rly Station Road | TRIVANDRUM 695001   | 32 27    |

Printed at Printograph, New Delhi, India